Complex Cognitive Processes

Conceptual Understanding

- What Are Concepts?
- Promoting Concept Formation
Conceptual Understanding

*Concepts* are ideas about what categories represent, or said another way, how we group objects, events, and characteristics on the basis of common properties.

*Concepts* help us:

- simplify and summarize information
- generalize to new situations
- aid the process of remembering
- communicate more efficiently
Teaching Concepts: The rule-example strategy

- *Define the concept* – identify its key features
- *Clarify terms in the definition* – make sure the key features or characteristics are understood
- *Give examples* (and non-examples as well)
- *Provide additional examples* – involve students in generating more examples and have them explain their selections
Concept Map

Reptiles

Characteristics
- Lungs
- Usually egg-laying

Dinosaurs
- Attributes
  - Extinct
  - Reptilian

Non-Dino Reptiles
- Snakes
- Crocs
- Turtles

Types of Dinos
- T-Rex
- Triceratops
- Stegosaur
Prototype Matching

Prototypes: There are more typical examples of a concept

e.g., a robin flies, builds a nest in a tree, has a bird song, is a typical bird size

a penguin has none of these features

e.g., Lassie is a prototypic dog because she has qualities (like size, shape, bark) representative of dogs in general

a Chihuahua does not
Promoting Concept Formation

- Use the rule-example strategy
- Help students learn what a concept is and what it is not
- Provide clear, concrete examples
- Relate new concepts to already-known concepts
- Create concepts maps
- Generate hypotheses about concepts
- Prototype matching
- Check for understanding and generalization
Hypothesis-Testing

_Hypotheses_ are specific assumptions and predictions that can be tested
Thinking

...involves manipulating and transforming information in memory

...involves

- Reasoning
- Thinking critically
- Decision making
- Thinking creatively
Inductive Reasoning

- a good predictor of academic performance
- e.g., a student reads a few Emily Dickinson poems and draws conclusions about the general nature of her poetry
- e.g., a teacher prompts several students to engage in self-explanation during math problem-solving and draws the conclusion it promotes deeper understanding
Deductive Reasoning

- During adolescence students are increasingly able to reason deductively

- **Valid Conclusion?**

  All things that have a motor need oil
  Automobiles need oil
  Therefore, automobiles have motors

  War times are prosperous times, and prosperity is highly desirable; therefore, wars are much to be desired
Critical Thinking

... is thinking reflectively and productively, and evaluating the evidence.

Mindfulness versus Mindless

*Mindful* students are alert, open to new information, cognitively flexible, are aware of more than one perspective.

*Mindless* students are entrapped in old ideas, engage in automatic behavior, accept what they read or hear without questioning, operate from one perspective.
Ways Teachers Can Encourage Critical Thinking

- Help students construct their own thinking
- Use thinking-based questions
- Provide positive role models for thinking
- Be a thinking role model for students
- Keep up-to-date on latest developments in thinking
Cognitive Changes in Adolescence that Allow/Promote Improved Critical Thinking

- Increased speed, automaticity, and capacity of information processing
- More knowledge in a variety of domains
- Increased ability to construct new combinations of knowledge
- Greater range and more spontaneous use of strategies or procedures such as planning, considering alternatives, cognitive monitoring
Decision Making

*Decision making* involves thinking in which individuals evaluate alternatives and make choices among them.

**Confirmation bias**: The tendency to search for information that supports our ideas rather than refutes them.

**Belief perseverance**: The tendency to hold on to a belief in the face of contradictory evidence.
Overconfidence bias: The tendency to have more confidence in judgments and decisions than we should, based on past experience.

Hindsight bias: The tendency to falsely report, after the fact, that we accurately predicted the event.
Creative Thinking

...is the ability to think about something in novel and unusual ways and come up with unique solutions to problems.

Convergent Thinking
Produces one correct answer.
e.g., 4 + 7 + ?

Divergent Thinking
Produces many answers to the same question.
e.g., write a poem
Components of Divergent Thinking

1) Fluency = number of solutions that fit the requirements of a problem

2) Flexibility (originality) = number of unusual or unique solutions. Solutions generated by few or no other people

Unusual Uses Test

e.g., list as many as possible uses for a “brick.”
Steps in the Creative Process

- **Preparation:** immerse yourself in a problem
- **Incubation:** churn ideas around in your head
- **Insight:** often you’ll experience an “Aha!” moment when all the pieces of the puzzle fit
- **Evaluation:** now decide whether the idea is valuable and worth pursuing
- **Elaboration:** this final step covers the longest time span of time and involves the hardest work – implementing the idea
Ways to Improve Creativity

- Encourage creative thinking on an individual and group basis
- Provide stimulating environments
- Guide students to be persistent and delay gratification
- Encourage internal motivation
- Involve creative people
Ways to Improve Creativity cont’d

- Guide students to help them think in flexible ways
- Encourage students to take risks
- Don’t overcontrol students
- Build students’ confidence